

Synopsis of the Hawaiian Diaspinae (Coccidae)

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The Coccidae, on account of their economic importance, have received a large share of attention in Hawaii, but owing to the confusion which prevailed for years in the specific identification and grouping of these insects (growing out of the attempt to elucidate this large group hurriedly through work in different and widely separated countries), the earliest records of these insects here present quite a few inaccuracies in regard to species determination and are not even to be relied on as valid representations in a few cases, since some of the examples on which the records are based were evidently taken from newly imported horticultural plants. For instance, the following species listed by Kirkaldy in Fauna Hawaiiensis, Hemiptera, are not generally recognized here now, viz.: *Aspidiotus persearum*, *A. perniciosus*, *A. transparens* (*lataniae*?), *greeni*, *duplex* (*P. clavigera*?), *Diaspis patelliformis* (*S. pentagona*?), *Lepidosaphes pinnaeformis* (*L. beckii*?), *L. pomorum*, *Howardia prunicola* and *Fiorinia pellucida* (*F. fioriniae*?); nor are *Chionaspis citri* and *Aspidiotus destructor* of Kotsinsky's list. On the other hand there are a few well-recognized species here that are not placed in either of these lists and one or two possibly that have never been recorded here. To the best of my knowledge the following species represent the present diaspine fauna (numerals refer to table of literature consulted, following):

Parlatoriini

Parlatoria proteus var. *crotonis* (15,
25, 32)

" *mytilaspiformis* (8)

" *zizyphus* (2, 32)

Leucaspidini

(none)

Lepidosaphini

Lepidosaphes gloveri (8, 25, 26, 32) *Ischnaspis longirostris* (3, 32)

" *auriculata* (22, 24) *Lepidaspidis uniloba* (27, 32)

" *beckii* (8, 25, 26, 32) *Andaspis flava* var. *hawaiiensis* (7,

" *pallida* (8, 32) 30)

Diaspidini

<i>Aulacaspis rosae</i> (25, 32)	<i>Pinnaspis (Hemichionaspis) burxi</i>
" <i>fulleri</i> (10, 32)	(15)
" <i>major</i> (23, 29, 31)	" <i>minor</i> (32)
<i>Diaspis boisduvali</i> (25, 32)	" <i>aspidistrae</i> (8, 25, 32)
" <i>bromeliae</i> (32)	<i>Howardia biclavata</i> (8, 32)
" <i>echinocacti</i> (32)	<i>Tsukushiaspis pseudoleucaspis</i> (16,
<i>Phenacaspis eugeniae</i> var. <i>sand-</i>	32)
<i>wicensis</i>	

Fioriniini

<i>Fiorinia fiorinae</i> (8, 12, 32)
" <i>nephelii</i> (13, 24)

Aspidiotini

<i>Aspidiotus lataniae</i> (8, 11, 25)	<i>Odonaspis secreta</i> (8)
" <i>rapax</i> (8, 25)	" <i>ruthae</i> (21, 33)
" <i>hederae</i> (8, 25)	<i>Morganella maskelli</i> (4)
" <i>cyanophylli</i> (8, 9, 25)	<i>Pseudaonidia clavigera</i> (9)
<i>Chrysomphalus aonidum</i> (9, 25)	
" <i>dictyospermi</i> (4, 9, 25)	
" <i>rossi</i> (8, 9)	
" <i>aurantii</i> (8, 9, 25)	

I give below a tentative list of host-plants. This could no doubt be considerably amplified with a little intensive work on this group.

<i>Andaspis flava</i> var. <i>hawaiiensis</i> —bark of shade trees.
<i>Aspidiotus cydoniae</i> —guava, Cycas, klu
" <i>rapax</i> —citrus
" <i>hederae</i> —Platydesma
" <i>cyanophylli</i> —sugar cane, mango, wistaria, avocado, Eugenia
<i>Aulacaspis rosae</i> —rose
" <i>fulleri</i> —Aglaia
" <i>major</i> —litchi, longan
<i>Chrysomphalus aonidum</i> —Cycas, citrus, coconut
" <i>dictyospermi</i> —palms, ferns, Verschaffeltia
" <i>rossi</i> —Araucaria
" <i>aurantii</i> —Cycas, citrus
<i>Diaspis boisduvali</i> —orchids
" <i>bromeliae</i> —pineapple
" <i>echinocacti</i> —Cereus
<i>Fiorinia fiorinae</i> —avocado
" <i>nephelii</i> —litchi

- Howardia biclavis*—papaya, Plumeria, Nephelium, hibiscus, Ficus, Cassia
Ischnaspis longirostris—palm
Lepidaspidis uniloba—maïle
Lepidosaphes gloveri—citrus, croton
 " *auriculata*—croton
 " *beckii*—citrus, coconut
 " *pallida*—juniper
Morganella maskelli—fig
Odonaspis secreta—bamboo
 " *ruthae*—manienie
Parlatoria proteus var. *crotonis*—croton
 " *mytilaspidiformis*—orchids, croton
 " *zizyphus*—citrus
Phenacaspis eugeniae var. *sandwicensis*—oleander, mango, coconut, kukui
Pinaspis (Hemichionaspis) buxi—Philodendron, lauhala
 " *minor*—hibiscus, avocado, geranium, yams, ferns
 " *aspidistrae*—ferns
Pseudaonidia clavigera—grape, loquat, tamarind pods
Tsukushiaspis pseudoleucaspis—bamboo

Field Key to Species

1. Diaspines that are specific in their host relationship..... 2
 Diaspines that are not specific in their host relationship.....10
2. Female scale short oval to rectangular in outline (on croton).....
 *Parlatoria proteus* var. *crotonis*
 Not so 3
3. Female scale longitudinal, i.e., elongate, sometimes narrow in front,
 more or less broadened behind..... 4
 Female scale circular..... 6
4. Female scale six times as long as wide (on bamboo).....
 *Tsukushiaspis pseudoleucaspis*
 Female scale not more than three times as long as wide..... 5
5. Female scale with only one exuvia at anterior end; orange yellow,
 exuvia dark brown (on litchi).....*Fiorinia nephelii*
 Female scale with two exuviae at anterior end, entirely white, semi-
 diaphanous, exuviae pale stramineous (on croton).....
 *Lepidosaphes auriculata*
6. Female scale with exuviae in center..... 7
 Female scale with exuviae marginal..... 9
7. Female scale dark colored (reddish brown), exuviae blackish (on
 Araucaria)*Chrysomphalus rossi*
 Female scale light colored (chalky white), exuviae straw yellow..... 8
8. Bamboo-inhabiting species.....*Odonaspis secreta*
 Bermuda-grass-inhabiting species.....*Odonaspis ruthae*
9. Rose-inhabiting species.....*Aulacaspis rosae*
 Litchi and longan-inhabiting species.....*Aulacaspis major*
 Aglaia-inhabiting species.....*Aulacaspis fulleri*
 Cactus-inhabiting species.....*Diaspis echinocacti*
 Pineapple-inhabiting species.....*Diaspis bromeliae*
 Orchid-inhabiting species.....*Diaspis boisduvali*

10. Scales found principally on or under bark.....11
 Scales found principally on leaf or stem.....13
11. Female scale light colored (under bark), greyish stained with yellow, which is the color of the first exuvia; second dull crimson, secretionary covering opaque white; scales circular, exuviae central.....*Howardia biclavis*
 Female scale dark colored.....12
12. Female scale circular, 2.5 mm. diameter, moderately convex, blackish, entirely covered by the epidermis of the twig except the small shining sublateral orange-ferruginous exuviae.....*Pseudaonidia clavigera*
 Female scale circular to broad oval, 1 mm. diameter, tolerably convex, pitch black; exuviae concolorous, very inconspicuous; placed toward the side.....*Morganella maskelli*
 Female scale mytiliform, thin, flat and more or less transparent, 1.5 mm. long, color varying from pale brown to dark brown, exuviae terminal, rather dull copper colored and about one-fourth length of scale.....*Lepidosaphes hawaiiensis*
13. Female scale short oval to rectangular in outline, black.....*Parlatoria zizyphi*
 Not so14
14. Female scale longitudinal.....15
 Not so, circular, with exuviae in center.....24
15. Female scale filiform, six times as long as wide, black.....*Ischnaspis longirostris*
 Female scale mytiliform.....16
16. Female scale with only one exuvia (the first) at basal extremity; small, brownish in color (common on avocado).....*Fiorinia fioriniae*
 Not so; female scale with two exuviae at cephalic end.....17
17. Female scale not expanded or broadened much caudally.....18
 Female scale narrow in front, broadened behind.....19
18. Female scale 2.5 mm. long, .5 mm. wide, very dark reddish brown, almost black, exuviae pale straw color, 2nd exuvia $\frac{5}{8}$ mm. long, less than half as wide, secretionary portion of scale extending along sides half its length, 1st exuvia .25 mm. long, overlapping second very little (on maile).....*Lepidaspidis uniloba*
 Female scale 1.5-2 mm. long, .5-1 mm. wide, brownish fulvous, semi-transparent, paler at margin, exuviae clear yellow, occupying less than half total length of scale (on orchids, crotons).....*Parlatoria mytilaspiformis*
19. Female scale white, pyriform, exuviae pale fulvous.....*Phenacaspis eugeniae* var. *sandwicensis*
 Female scale brown.....20
20. Female scale small, 2nd larval exuvia large, one-third length of scale....*Pinnaspis buxi*
 Not so, female scale normal.....21
21. Medium brown to dusky, caudal margin pallid.....*Lepidosaphes pallida*
 Caudal margin not pallid.....22
22. Male scales white and tricarinate, wax felted.....*Pinnaspis minor* and *P. aspidistrac*
 Male scales concolorous and without carinae.....23

23. Female scale long and narrow, more than three times as long as wide....
 *Lepidosaphes gloveri*
 Female scale shorter and wider, less than three times as long as wide
 *Lepidosaphes beckii*
24. Female scale dark colored.....25
 Female scale light colored.....26
25. Female scale black with red nipple.....*Chrysomphalus aonidum*
 Female scale without red nipple but with white dot in center.....
 *Chrysomphalus dictyospermi*
26. Female scale transparent, colorless, exuviae bright yellow.....
 *Aspidiotus cyanophylli*
 Female scale pale yellowish gray, exuviae reddish, small spot and ring
 of white on nipple.....*Chrysomphalus aurantii*
 Female scale white or pale ochreous, exuviae brownish yellow or straw
 colored*Aspidiotus lataniae*
 Female scale grey ochreous, exuviae castaneous brown, white ring on
 nipple*Aspidiotus rapax*
 Female scale dull ochreous, exuviae yellow.....*Aspidiotus hederac*

Key to Genera of Diaspinae in Hawaii

The following key to the genera is largely based on morphological characters which can only be made out in carefully prepared specimens with the aid of the compound microscope.

1. Caudal margin of adult female with a single, entire median lobe (median lobe undivided) 2
 Caudal margin with median lobes at least (median lobes divided)..... 3
2. Scale and insect elongate.....*Lepidaspidis*
 Not so, scale and insect round or oval.....*Odonaspis*
3. Median lobes of caudal margin divergent and serrate on inner edge.... 4
 Not so, median lobes parallel and without serrations on inner edge.... 7
4. Adult female small, inclosed in the second exuvia, only one exuvia, that of the first larva, at basal extremity of scale, second present, however, but inclosing like a puparium the very much reduced adult female insect as stated.....*Fiorinia*
 Not so; more than one exuvia at narrow end of female scale..... 5
5. Exuviae marginal, outline of scale subcircular, pyriform or elongate....
 *Phenacaspis*
 Exuviae within the margin of scale, which is circular..... 6
6. Dorsal tubular gland openings scattered, not arranged in distinct rows; median lobes rather widely separated.....*Diaspis*
 Dorsal tubular gland openings arranged in distinct rows, inner margin of median lobes close together at base.....*Aulacaspis*
7. Female with slender, elongate, chitinous processes extending inward from base of lobes.....*Chrysomphalus*
 Chitinous processes short or absent, or if longer, clubbed..... 8

8. With branched plates (bracteae) on some of the segments anterior to the pygidium, two rows of isolated pores near caudal margin of female *Parlatoria*
Without branched plates (bracteae) on segments anterior to the pygidium 9
9. Female scale circular or nearly so 10
Female scale always elongate 13
10. Female scale with exuviae overlapping and placed at or close to anterior extremity, a conspicuous pair of stout, club-shaped paraphyses; lateres crowded with branched and spinous plates *Howardia*
Female scale with exuviae completely superposed and more or less centrally situated (in male as well) 11
11. Female with an extensive reticulated tract on the dorsal surface of the pygidium *Pseudaonidia*
Female without reticulated tract on dorsal surface of pygidium 12
12. Pygidium of adult female without genacerores *Morganella*
Pygidium of adult female with genacerores *Aspidiotus*
13. Scale of female about 8 times longer than broad, sides nearly parallel 14
Scale of female less than 8 times longer than broad, narrow at the anterior end, broadening posteriorly 15
14. Pygidium of female with reticulations on dorsal surface *Ischnaspis*
Pygidium of female without reticulations on dorsal surface *Tsukushiaspis*
15. Male scale with a thinner transverse band on cauda providing a hinge for the lifting of caudal end; median lobes of pygidium of female separated, usually with spines between 16
Male scale not provided with a hinge, median lobes usually close together *Pinnaspis*
16. Pygidium of adult female with paraphyses *Andaspis*
Pygidium of adult female without paraphyses *Lepidosaphes*

The tribal affiliation of cited species is indicated in the species list which precedes. For a table of tribal distinctions, one is referred to MacGillivray's excellent manual. Consideration of the genera is next in order and for economy of space only a short generic characterization is made. Where reference can be given to an adequate description in coccid literature locally available the species are not described at length. In a few cases, however, it is necessary to do this and to add to completeness of treatment tables and figures are duly supplied.

Genus *PARLATORIA* Targ.

Targ., Cat., p. 42 (1869).

This genus includes species of the Diaspinae having the scale of the adult female circular to oval in form, whitish to gray or black in color; exuviae marginal; body of the adult female ap-

proximately oval; pygidium with three pairs of well-developed lobes, the fourth somewhat developed and all more or less distinctly notched, at least on the outer side; a fringe of finely toothed plates between the lobes, and a series of thick-walled, broad-mouthed marginal glands placed parallel to the body margin; scale of the male oblong, non-carinated and rather narrow, with the exuvia placed at the anterior extremity.

So far as the author can ascertain we have but 3 species of this genus in Hawaii. They may be distinguished by the following key:

1. Scale of adult female with second exuvia of medium size, never covering one half of scale..... 2
 Scale of adult female with second exuvia large, covering two-thirds or more of scale, black; pygidium of adult female with lobes distant, median, second and third pairs bluntly rounded, entire; distapectinae broad, not truncate, approaching latapectinae in form; anus and vulva located near line drawn between pregenacerores and post-genacerores, altaceratubae about 17, one mesal and 8 on each side; genacerores (6-7), 7-10.....*sizyphi*
2. Scale of female circular or oval, never twice as long as wide, orange yellow, sometimes tinged with green; exuviae yellowish, darker than excretionary portion; lobes comparatively narrow, subconical, bluntly pointed, with more or less distinct mesal and lateral notches; pectinae broad and deeply toothed; altaceratubae 19, one mesal and 9 on each side; anus located midway between vulva and caudal margin; spiracerores wanting; genacerores (5-7); 4-7.....*proteus* var. *crotonis*
 Scale of adult female elongate with subparallel sides, more than twice as long as wide, brownish fulvous, exuviae yellow; lobes comparatively narrow, distant, end bluntly pointed with mesal, and lateral notches; fourth pair of lobes sometimes represented by rudiment; pectinae of median, second and third incisurae narrow, others wide; spiracerores wanting; genacerores (6-6) 5-5; brevaceratubae numerous; altaceratubae distinct one mesal and nine on each side; anus located midway between vulva and caudal margin.....*mytilaspiformis*

Genus LEPIDOSAPHES Shimer

Tr. Am. Ent. Soc. I, p. 373 (1868).

This genus includes species of Diaspinae in which the scale of the adult female is elongate, narrowed in front and gradually broadening behind, more or less curved, variable in color but generally orange brown to dark brown, exuviae terminal, second one covered. Male scale similar to that of female, but much smaller and narrower, exuviae terminal. The posterior part of the scale is separated by a thin transverse band of secretion

which functions as a hinge, permitting the extremity of the scale to be raised so that the adult can emerge.

Body of adult female elongate also, margins of some of the segments often produced. Circumgenital gland orifices in five groups. A pair of median lobes well developed; second pair cleft to form two lobules, of which the inner is larger. No incisions or chitinous thickenings present. Gland spines are usually arranged as follows on either side median line: 2 between median lobes, 2, 2, 2 and 2. Anal opening small, relatively close to base of pygidium. Marginal gland orifices prominent, usually arranged as follows on either side median line: 1, 2, 2, and 1. Dorsal gland orifices present, arranged in 2-3 rows. Ventral thickenings distinct.

Type *L. ulmi* (Linn.).

Three species belonging to this genus are found in Hawaii, which may be differentiated with the following key:

1. An ear-like lateral lobe on either side at base of cephalic area; pygidium without plates in second incision.....*auriculata*
No ear-like lateral lobe present; pygidium with plates in second incision 2
2. Margin of penultimate and two preceding segments of body with chitinous spur; genacerores 4, 6, 4.....*gloveri*
Margin of penultimate and two preceding segments of body without chitinous spur 3
3. Mesogenacerores never less than 5.....*beckii*
Mesogenacerores never more than 4.....*pallida*

Genus ISCHNASPIS Douglas

Ent. Mo. Mag. XXIV, p. 21 (1887).

This monotypical genus of the Diaspinae is distinguished by the following characteristics: The scale of the adult female is extremely long and narrow, with the first exuvia extending beyond the anterior margin; black in color and shiny. The body of the adult female is very long and narrow, the posterior margin of the pygidium forming a regular shallow concave depression from which the median lobes project. The dorsal surface of the pygidium has a peculiar latticework design. Circumgenital glands in five small groups, sometimes, however, difficult to make out in their entirety. The male scale is elongate, similar to that of the second-stage female, and without the central hinge.

Type *I. longirostris* (Sign.).

I. longirostris is a fairly common species in Hawaii on palms.

Genus LEPIDASPIDIS MacGill.

Coccidae, MacGillivray, p. 292 (1921).

This genus is distinguished from *Lepidosaphes* by the fused condition of median lobes and absence of secondary ones. The genus is monotypic.

Single large mesal lobe crenulate; four distant plates on each side, cephalic two much larger than caudal two; genacerores present; caudal segments of preabdomen with two large plates; segments not deeply constricted.

Type not designated.

Only one species, viz. *L. uniloba* (Kuw.).

Genus ANDASPIS MacGill.

Coccidae, MacGillivray, p. 292 (1921).

This genus is distinguished from *Lepidosaphes* by the presence of paraphyses in the adult female and the absence of secondary lobes. The lobes are triangular, lateral margin long, minutely serrate, mesal notch small. Plates longer than the lobes, arranged 2, 1-2-2-1. Margin with six altaceratubae arranged 1, 2, 2, 1. Dorsal oraceratubae small, in two rows. Genacerores present.

Type not designated.

Only one species found in Hawaii, viz. *A. hawaiiensis* (Mask.).

NOTE: *Andaspis* (*Lepidosaphes*) *hawaiiensis* is not common in Hawaii—at least it has not been found in general collecting; yet in Florida this scale is common enough to be feared as a serious pest.

Genus AULACASPIS Cockerell

Journ. Inst. Jam. I, p. 180 (1893).

This genus includes species of Diaspinae in which the scale of the adult female is circular to oval, white, exuviae subcentral to submarginal. Scale of male small, elongate, parallel-sided, white, felted (wax), dorsal surface tricarinate or unicarinate. Body of the female elongate ovate, tapering posteriorly or (in aberrant species) subcircular; pallid with pygidium reddish brown, cephalothorax one-third to one-half the body; abdomen distinctly segmented.

Type *A. rosae* (Bouché).

There are three species belonging in this genus found in Hawaii, which may be differentiated by the use of the following key:

1. Adult female circular, lateral lobes undeveloped, circumgenital pores very numerous, each group 50 or more (on litchi).....*major*
 Adult female elongate, lateral lobes developed, circumgenital pores less numerous, all groups considerably less than 50..... 2
2. Inner margin of median lobes almost entire, six to seven gland spines on pygidial margin near penultimate segment (on Aglaia).....*fulleri*
 Inner margin of median lobes distinctly serrate, usually four gland spines on pygidial margin near penultimate segment (on rose).....*rosae*

Genus DIASPIS Costa

Prospetto nuova Div. Met. Coccus p. 7 (1828).

This genus includes species of Diaspinae in which the scale of the adult female is circular or subcircular, exuviae situated well within the margin. The first exuvia is naked or with an almost imperceptible secretory covering, the second exuvia occupies about one-fourth the diameter of the scale and is covered by a layer of secretion. The scale of the male is small, elongate, approximately parallel-sided, white, felted (wax), tricarinate, the exuvia at the cephalic end. Body of female oval or nearly so, yellowish tinged reddish or brownish, cephalothorax pronounced, rounded (bearing in *D. boisduvali* a prominent tubercle), segmentation of the abdomen rather indistinct. Pygidium with three pairs of well-developed lobes, the fourth obscurely developed; median lobes widely separated, deeply sunken into apex of pygidium, which really forms a concavity. Circumgenital gland orifices present fairly numerous, arranged in five groups. Marginal gland orifices present, arranged as follows on either side of the median line: 1 between median lobes, then 1, 2, 2, 1.

Type *D. calyptroides*=*echinocacti*.

Three species belonging to this genus are found in Hawaii, which may be differentiated with the following key:

1. Thoracic segment with a large projecting tubercle.....*boisduvali*
 Not so 2
2. Inner margin of median lobes free and serrate; dorsal gland orifices large*bromeliae*
 Both margins of median lobes free and non-serrate; dorsal gland orifices small and numerous.....*echinocacti*

Genus PHENACASPIS Cooley & Cockerell

Check List Coccidae, Suppl., p. 398 (1899).

This genus includes species of the Diaspinae in which the scale of the female resembles that found in the genus *Chionaspis*, that is to say, it is elongate, narrow in front, more or less broadened behind, white, exuviae terminal at the cephalic end. The scale of the male is much smaller than that of the female, elongated, parallel-sided, exuvia at anterior end, unicarinate or tricarinate. The pygidium of the female is also like that of *Chionaspis* except that the median lobes are well separated, more or less sunken into the apical margin of the pygidium and have their inner margins serrate or crenate and strongly divergent, leaving a distinct notch in the median line.

Type *P. nyssae* (Comst.).

There is but one species of this genus found in Hawaii, viz., *Phenacaspis eugeniae* var. *sandwicensis*. The variety is here described as new.

***Phenacaspis eugeniae* (Maskell) var. *sandwicensis* nov.**

Scale of female pyriform, only slightly convex and indistinctly carinate; length 2.5 mm., greatest width 1.5 mm.; white, surface smooth, somewhat glabrous and showing only transverse lines of growth; exuviae at anterior, narrow end pale fulvous in color; second exuviae .75 mm. long, twice length of first and overlapping first half its length.

Scale of male elongate, sides parallel, tricarinate; white, (wax) felted, 1 mm. long, exuvia at anterior end pale fulvous, about .3 mm. long.

Body of female elongate ovate, 2 mm. long, less than 1 mm. wide, pale yellow, pygidium with brownish tinge posteriorly, antennae with basal knob cuspid internally, a long curved seta extending therefrom, dorsum posterior to a transverse line through apex of rostrum marked by two submedian, subparallel linear stomata diverging posteriorly. Anterior spiracles having well-defined parastigmatic glands and removed laterally from apex of rostrum a distance equal to width of latter at base. Posterior spiracles placed a little anterior to middle of body, about equidistant from each other and margin of body. Median lobes of the pygidium divergent at 90 degree angle and projecting one-third their length from an obtuse posterior notch, well separated at bottom where there are two setae (plates), outer portion of interior margin minutely dentate. Exterior to median lobes a seta and between them and the divided second lobes a plate, between the second pair of lobules and the broad truncate third pair also a seta and a larger plate, another seta at base of outer lobule. Beyond the lobules the margin is very irregular, bearing four stout plates, one directly beyond, two near together at anterior end and one about midway between; the two segments of the preabdomen anterior each bear three shorter plates on or near the lateral

margin. There is a submarginal row of breviceratubae or marginal pores as follows: 1 between 1 and 2 lobes, 2 between 2 and 3 lobes, 2 between 1 and 2 plates on lateris, 2 between 2 and 3 plates and 1 between 4 and 6 small plates; and four segmental rows consisting of a median and a lateral portion proceeding caudad on 2nd segment: 4 median and 9 lateral, on 3rd, 5 median and 7 lateral, on pygidium 5 median (in two rows) and 4 lateral. Anus a little anterior to center of pygidium. Circumgenital glands in five groups as follows: anterior 8, anterior laterals 16, posterior laterals 21. Pygidium in stained specimens displaying fine striations and several rows of longitudinal darker markings similar to paraphyses, behind median lobes.

Genus PINNASPIS Cockerell

(HEMICHIONASPIS)

Journ. Inst. Jam. I, p. 136 (1892).

The species included in this genus have the scale of the adult female more or less pyriform in outline, with the exuviae at the anterior extremity. First exuvia naked, second more or less covered by secreted matter. Secreted portion varying from white to brown or yellowish. The body of the female is elongate, broadened posteriorly, conspicuously segmented. Abdominal segments with a more or less distinct group of small nearly circular gland orifices on each side, more distinct near the pygidium. More or less distinct rows of oval gland orifices on the dorsal surface between the segments. A group of gland spines on each side of the abdominal segments, more distinct near the pygidium than anteriorly. The characters of the pygidium are as follows: One, two or three pairs of lobes present. Median lobes with their inner edges straight, parallel, and close to each other or touching for their entire length, the outer edges being rounded and either crenate or serrate. These two lobes together form approximately a semicircle, and are darker than the other lobes. Lobes of the second and third pairs, when present, composed of two lobules, of which the inner is larger than the outer. Gland spines simple and usually quite large and conspicuous. Spines usually plainly visible; those on the dorsal longer than those on the ventral surface. Circumgenital gland orifices always present and arranged in five groups. Scale of male elongate, unicarinate or tricarinate: ventral scale complete forming with the upper part a tube.

Type *P. pandani*=*buxi* (Bouché).

There are three species belonging to this genus in Hawaii, which may be differentiated as follows:

1. Second exuvia large, occupying more than one-third the puparium.....*buxi*
Second exuvia not so large..... 2
2. Median lobes small, somewhat sunken into the pygidium.....*aspidistrae*
Median lobes crenate.....*minor*

Genus HOWARDIA Berlese & Leonardi

Riv. Pat. Veg. IV, p. 347 (1896).

This genus will contain the somewhat peculiar species of the Diaspinae characterized as follows: Scale of the adult female more or less oval to elongate, with the exuviae at or near the margin. Scale usually covered by the outer layers of the bark of the host plant. Pygidium with median lobes well developed and with a pair of clubbed paraphyses. Circumgenital gland orifices wanting and without marginal gland orifices. Male scale unknown.

Type *H. biclavis* (Comst.).

There is but one species of this genus found in Hawaii, viz., the type species referred to above.

Genus TSUKUSHIASPIS Kuwana

Imp. Jap. Dept. Agr. Sci. Bul. I, pt. 1, p. 30 (1928).

The species included in this genus of the Diaspinae have both female and male scales similar to those found in species of Chionaspis, that is, scale of the female elongate, narrow in front, more or less broadened behind, generally white or pale yellow, exuviae at the cephalic end; scale of the male small, elongate, slender, sides parallel or nearly so, white, generally tricarinate, exuvia terminal at the cephalic end. The body of the adult female is slender, sides nearly parallel, a more or less distinct row of oval gland orifices on the dorsal surface. Two pair of lobes present. Fimbriate processes (in the nature of squames) on the margin of the pygidium, shorter than lobes. No incisions or chitinous thickenings. Gland spines simple, much longer than lobes. Marginal gland orifices present, arranged as follows: 1 between the median lobes, on each side of the median lobes as 1, 1, 1. Anal opening small, nearer to the base than apex of pygidium. Circumgenital

gland orifices present, arranged in five groups. The distinctive characters are the presence of the fimbriate processes on the margin of the pygidium and the marginal gland orifice between the median lobes.

Type *T. pseudoleucaspis* (Kuw.).

There is but one species of this genus found in Hawaii, viz., the type species referred to above, which has previously been known as *Leucaspis bambusae*. It occurs commonly on a bamboo (*Phyllostachys* sp.).

Genus FIORINIA Targ.

Targ. Cat., p. 42 (1869).

The species included in this genus have but a single exuvia at basal extremity of female scale; the second is present but incloses the small adult female, the insect decreasing in size after second moult; the puparium so formed is more or less elongate narrow at the base, widening a little apically perhaps; sides, however, generally stated parallel, first larval exuvia extending beyond the margin. The male scales are white, elongate, with or without carinae, larval exuvia at anterior or basal extremity. Pygidium of adult female possessing well-defined median lobes (some species with a small pair on either side as well) and plates; circumgenital gland openings normally in five groups, although in some species the median and anterior laterals coalesce, forming an arch. Sometimes absent.

Type *F. fioriniae* Targ.

Two species belonging in this genus are found in Hawaii, which may be differentiated as follows:

With circumgenital gland openings, two pairs of lobes, spinous tubercles only on anterior portion of margin (on avocado).....	<i>fioriniae</i>
Without circumgenital gland openings, only one pair of lobes, spinous tubercles along entire margin (on litchi).....	<i>nephelii</i>

Genus ASPIDIOTUS Bouché

Naturg. Schädli. Gart. Inss., p. 52 (1833).

This genus includes species of Diaspinae in which the scale of the female is circular or nearly so, with the exuviae at or near the center, and the scale of the male somewhat elongated, with

the larval skin at one side of the center or near one extremity. The last segment of the female usually presents four groups of spinnerets. In a few species there are five groups, and in some they are wanting.

Type *A. hederæ* (Vall.).

Four species belonging to this genus are found in Hawaii, which may be differentiated with the following key:

1. Pygidium of adult female always without genacerores, scales grayish or yellowish.....*rapax* (*camelliae*)
Pygidium of adult female always with genacerores..... 2
2. Pygidium of adult female always without densariae or paraphyses; scale very dull pale yellow, often whitish in well-protected specimens; thin, somewhat transparent; exuviae central, yellow, covered in newly molted adult females but usually bare in older individuals.....*hederæ*
Pygidium of adult female always with densariae or paraphyses..... 3
3. Pygidium of adult female with three pairs of lobes; scale brownish yellow; exuviae central, bright yellow, covered with white secretion*cyanophylli*
Pygidium of adult female with a single pair of lobes; scale clear yellow, translucent at center, exuviae large.....*lataniae*

Genus CHRYSOPHALUS Ashm.

Am. Ent. III, p. 268 (1880).

This genus of the Diaspinae includes the species similar in most respects to the species of *Aspidiotus supra*; however, there are always paraphyses present, and in that particular they are different.

Type *C. ficus* Ashm.

There are four species belonging to this genus found in Hawaii, which may be differentiated by the use of the following key:

1. Circumgenital gland openings absent, scale orange or reddish (on citrus)*aurantii*
Circumgenital gland openings present in adult female..... 2
2. Two outer rows of dorsal gland openings numerous and each arranged in a double row; marginal plates beyond the third lobes strongly pectinate along their margins; scale blackish with the covered exuviae reddish (on citrus, *Cycas*, and coconut).....*aonidium* (*ficus*)
Two outer groups of dorsal gland openings few in number and each arranged in a single row..... 3
3. A conspicuous pair of long, serrated plates laterad of third lobe; scale grayish-white, exuviae light yellow (on palms).....*dictyospermi*
Not so; that is without a conspicuous pair of long, serrated plates laterad of third lobe; scale deep, dull brown, almost black, nipple yellowish (on *Araucaria*)*rossi*

Genus ODONASPIS Leon.

Riv. Pat. Veg. V, p. 284 (1897).

Species included in this genus have the scale of the adult female circular or subcircular in outline with the exuviae placed to one side of the center. The scale of the male is more elongate and strongly convex above, exuviae near anterior extremity. Body of female is broadly oval, rather flat, with integument at caudal end strongly chitinized. Pygidium broad and triangular, terminating in a large and apparently single, fairly prominent median lobe, or the equivalent thereof; other lobes more or less indistinctly formed, merely indicated by lesser or slight prominences; no plates whatsoever but a few marginal spines present. Circumgenital glands usually present, also distinct paraphyses, and the pygidial area dotted with small pores or gland openings.

Type *O. secreta* (Ckll.).

Two species belonging to this genus are found in Hawaii, which may be differentiated with the following key:

- Pygidium without incisions, anterior circumgenital glands 12-17, lateral 29-33, numerous dorsal pores on either side of median and second pair of lobes (on Bermuda grass).....*ruthae*
 Pygidium with incisions, no anterior circumgenital glands, laterals in first group numbering 80-90, dorsal pores inconspicuous (on bamboo) *secreta*

Genus MORGANELLA Cockerell

U.S.D.A. Bul. Ent. t.s. 6, p. 22 (1897).

This genus of the Diaspinae includes species similar in most respects to the species of *Aspidiotus supra*, but may be distinguished therefrom by the following characteristics: Closely adjacent or contiguous median lobes, which are long and slender, absence of other lobes, and orifice at base of lobes, and especially the very long spines.

Type *M. maskelli* (Ckll.).

There is but one species of this genus found in Hawaii, viz., the above-named type species, which some authorities consider the same as *M. longispina*, the other species included in the genus.

Genus PSEUDAONIDIA Cockerell

U.S.D.A. Bul. Ent. t.s. 6, p. 14 (1897).

The species included in this genus of the Diaspinae are similar in most respects to the species of *Aspidiotus* *supra*, but there is a peculiarity in the pygidium of the adult female: the dorsal surface has a latticework design like that in *Ischnaspis*.

Type *P. duplex* (Ckll.).

There is but one species of this genus found in Hawaii, viz., *P. clavigera* Ckll.

LITERATURE CONSULTED

- (1) 1867 Cat. Targioni-Tozzetti.
- (2) 1868 Les Cochenilles. Signoret.
- (3) 1887 Notes on British Coccidae. Douglas, Ent. Mo. Mag. XXIV, 21
Ischnaspis filiformis=*longirostris*, descr. & fig.
- (4) 1887 Observations on Coccidae. Morgan, Ent. Mo. Mag. XXV, 352
Aspidiotus longispina, *dictyosperma*, descr. & fig.
- (5) 1892 Museum Notes. Cockerell, Jn. Inst. Jam. I, 136. Descr. Genus
Pinnaspis.
- (6) 1894 Coccidae or Scale Insects. Cockerell, Bul. Bot. Dept. Jam. I.
Diagnosis Diaspines.
- (7) 1895 Coccid Notes. Maskell, Tr. N. Z. Inst. XXVII, 47. Descr.
Andaspis flava var. *hawaiiensis*.
- (8) 1896 Coccidae of Ceylon, Pts. 1 & 2. Green.
- (9) '96-'01 Coccidae. Leonardi, Riv. Pat. Veg. IV, V, VII, VIII.
- (10) 1901 South African Coccidae. Cockerell, Ent. 34, 225. Descr.
Aulacaspis crawi var. *fulleri*.
- (11) '97-'12 San Jose Scale & Allies. Cockerell, U.S.D.A. Bul. Ent. t.s. 6.
- (12) 1912 Genus *Fiorinia* in the U. S. Sasser, U.S.D.A. Bul. Ent. t.s. 16,
pt. 5.
- (13) 1898 *Fiorinia nephelii* descr. Maskell, Tr. N. Z. Inst. XXX, 234.
- (14) 1899 Chionaspis & Hemichionaspis. Cooley, Spec. Bull. Mass. Exp.
Sta. p. 8.
- (15) '01-'03 Monograph of British Coccidae. Newstead.
- (16) 1902 Coccidae of Japan. Kuwana, Pr. Cal. Acad. Sci. III, 43.
- (17) 1902 Fauna Hawaiiensis: Hemiptera. Kirkaldy.
- (18) 1903 Cat. Coccidae of the World. Fernald.
- (19) 1903 Mytilaspides, Parlatoria. Leonardi, Bol. R. S. Agr. Portici V.
- (20) 1905 *Fiorinia*. Leonardi, Redia III.
- (21) '05-'30 Proc. Haw. Ent. Soc. vols. I-VII.
- (22) 1907 Notes on Coccidae Seychelles. Green, Tr. Linn. Soc. London
Zool. XII, 2, 205, descr. & fig. *Mytilaspis auriculata*.
- (23) '14-'15 Some Ceylon Coccidae. Rutherford, Bul. Ent. Res. V, 259.
Descr. *Aulacaspis flacourtiae*.

- (24) 1915 Cat. Coccidae Australia. Froggatt, N. S. W. Dept. Agr. Bul. 14.
- (25) 1916 Coccidae of Indiana. Dietz & Morrison.
- (26) 1916 Report on Scale Insects. Comstock, Ag. Ex. Sta. N. Y. Bul. 372.
- (27) 1921 Coccidae. MacGillivray.
- (28) '21-'22 *Pinnaspis simplex*-*Lepidaspidis uniloba*. Ferris, Bul. Ent. Res. 12, 214, descr.
- (29) '21-'22 Coccidae from the Seychelles. Green & Laing, Bul. Ent. Res. 12, 128. Fig. *Diaspis flacourtiae*.
- (30) 1923 Scale Insects of Florida. Merrill & Chaffin.
- (31) 1924 Synonymical Notes on Coccidae. Morrison, Pr. Ent. Soc. Wash. 26, 231. *Aulacaspis flacourtiae*=*major*.
- (32) '25-'31 Coccidae of Japan. Kuwana, Tech. Buls. Imp. Jap. Dept. Agr.
- (33) 1926 Egyptian Coccidae. Hall, Egypt. Min. Agr. Bul. 72. Fig. *Odonaspis ruthae*.